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OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

November 20 - November 26, 1998

Summary 98-47

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EVENTS

1. SAVANNAH RIVER IDENTIFIES DEFECT IN PERSONAL RADIATION MONITORING DEVICE

On November 19, 1998, the Savannah River Health Physics Instrument Calibration Facility discovered an apparent recurring defect in the audible alarm circuit of a particular model of personal radiation monitoring device. The Siemens Electronic Personal Dosimeter, Model EPD1, is used at Savannah River to monitor workers who enter radiation areas. The device electronically records and stores information concerning the radiation levels to which workers are exposed. It also provides an audible alarm alerting the wearer to high exposure rates or excessive total exposures. The audible alarm feature appears to be defective on Version 8 of the Siemens EPD1. (ORPS Report SRS--WSRC-HPIH-1998-0001)

Savannah River recently received a number of the Version 8 units. As it was preparing some of the units for issue, the Calibration Facility discovered that two of them had lost their audible alarm capability. An inspection revealed poor connections in the speaker circuit. The fault does not prevent the device from measuring and recording exposure to radiation. An inspection of maintenance records revealed that several other Version 8 units had failed in a similar manner.

Savannah River has placed a hold on the use of Version 8 EPDs and is returning older versions to service until repairs can be made to all affected units. The Site has also notified Siemens AG and the DOE Health Physics Instrument Committee of the discovery.

KEYWORDS: alarm, dosimeter

FUNCTIONAL AREAS: Radiation Protection

2. HAZARDOUS MATERIALS DISCOVERED IN ABANDONED LABORATORY

On November 9, 1998, at the Los Alamos National Laboratory Physics Complex, personnel performing a management walkaround discovered a sealed 10-millicurie americium-241 source in a locked and partially dismantled laboratory. They discovered the source, which was not registered in accordance with site requirements, in a wood box inside a cabinet. The room was not designated a radiological control area and neither the source nor the cabinet shelves were properly posted for radiological control. While monitoring the room and its contents, radiological control technicians also discovered a 15-microcurie strontium-90 sealed source, encapsulated pieces of beryllium in marked plastic bags, a small quantity of mercury, a few grains of high explosive material in boxes, a 60-gram bottle of barium oxide, and some lead shielding material dating from the early 1980s. There were no hazard warnings posted on the shelves of the cabinet. The room also contained an asbestos safe. The abandonment of hazardous materials could have compromised employee health and safety. (ORPS Report ALO-LA-LANL-PHYSCOMPLX-1998-0005)

Radiological control technicians identified, surveyed, and inventoried the contents of the laboratory, and facility personnel are transferring or disposing of the hazardous materials in accordance with site procedures.

The facility manager initiated an investigation of the occurrence. Investigators determined that laboratory owners had not adequately evaluated this space, and possibly others at the facility, during a legacy

material inventory conducted during the past year. The uncontrolled condition of the laboratory was described during a critique as being "suspended in transition." Investigators determined that a scientist had stopped using the laboratory in 1997, when project funding was eliminated. The scientist had been moving equipment and supplies to a new location when he was reassigned to a different station. He had sorted chemicals and materials, placed them in various locations in the room, and labeled them to warn movers who were to remove equipment from the room. However, the room had remained locked in this condition since his departure.

NFS engineers reviewed two similar incidents involving abandonment or loss of control of hazardous materials.

- A waste management coordinator at the Los Alamos National Laboratory Target Fabrication Facility discovered two bottles of potentially explosive chemicals in an inoperable refrigerator during an inventory of legacy chemicals. One bottle contained benzoyl peroxide and the other contained 3-chloroperoxybenzoic acid. The Laboratory's Hazardous Device Team transported the chemicals to a large open area and destroyed them. Investigators determined that the chemicals were abandoned by an employee who had left the Laboratory approximately five years earlier, at which time there were no procedures to account for chemicals when employees vacate work spaces. (ORPS Report ALO-LA-LANL-TARGETFAB-1998-0001)

- At the Los Alamos National Laboratory Chemical and Laser Science Facility, a chemical technician searching for legacy chemicals in a transportainer discovered a small wooden box containing explosives in plastic packets and a metal tray containing hazardous chemicals. The materials had been stored in a cardboard moving box along with files and other papers belonging to a former technical staff member. Investigators determined that the materials had been removed from an approved explosives storage in violation of policies and procedures, transported over public roads, handled by personnel not authorized to handle explosives, and stored in an uncontrolled location for more than 6 months. They also determined that the group from which the materials originated did not have a process for clearing space when an employee leaves. (ORPS Report ALO-LA-LANL-CHEMLASER-1998-0002)

These occurrences underscore the importance of a systematic process for vacating laboratories. Laboratories throughout the DOE complex may be entirely or partially vacated because the facilities they support are shut down, because they experience changes in missions or ownership, or because projects by guest scientists or students are terminated. The condition of the laboratory space at the Physics Complex was degraded when packing, moving, and proper disposal of experimental hazardous materials were stopped owing to funding loss and inability to support the project staff. Lack of a formal exit procedure contributed to degraded laboratory conditions at the Target Fabrication Facility. Facility managers should ensure that planning and funding for both long-term and short-term laboratory use includes provision for controlled vacancy, and that formal procedures are in place to vacate laboratories safely. In December 1997, the Los Alamos National Laboratory issued formal requirements for occupying or vacating spaces, which laboratory managers have supplemented with their own formal requirements for the handling and disposition of chemicals during exit phases. The following guidance is quoted from ISBN 0-309-05229-7, *Prudent Practices in the Laboratory*, published by the National Academy Press for the National Research Council.

- Dispose of, or remove to storage, all hazardous chemicals at the completion of the laboratory supervisor's tenure or transfer to another laboratory. The institution's cleanup policy for departing laboratory researchers and students should be enforced strictly to avoid accumulation of orphaned unknowns.

- Develop and enforce procedures relating to transfer or disposal of chemicals and other materials when decommissioning laboratories.

KEYWORDS: chemical, decommissioning, hazardous material, laboratory

FUNCTIONAL AREAS: Chemistry, Decontamination and Decommissioning, Materials Handling and Storage

3. FIRE PROTECTION SYSTEM IMPAIRMENTS

This week, OEAF engineers reviewed two events involving the impairment of fire protection systems. On November 19, 1998, at the Mound Plant, Fire Department personnel inadvertently isolated a portion of a fire suppression system that was required by operational control requirements. A review of system drawings could have prevented this. On November 16, 1998, at the Pantex Plant, an inspector found an impaired fire alarm panel that should have had a Fire Department Impairment Tag. The alarm panel, located in a building that handles high explosives, was impaired (alarms blocked) for about a week because its impairment was forgotten. Documentation of the alarm panel status could have prevented this. Unplanned impairment of fire protection systems can prevent proper fire suppression operation or result in a failure to notify personnel of fire and smoke hazards. (ORPS Reports OH-MB-BWO-BWO01-1998-0012 and ALO-AO-MHSM-PANTEX-1998-0081)

At Mound, Fire Department personnel had isolated a sprinkler system to repair a leak in a trunk line that supplies the system. A fire watch was stationed while the system was impaired. When Fire Department personnel discovered that the isolation valve did not stop the leak, they closed a second valve. However, this valve also isolated a portion of the fire protection system in another building, where the system operational status is governed by an operational control requirement. Fire Department personnel did not realize their mistake until returning to the firehouse and reviewing drawings. They then notified the building manager that the system was impaired and established a fire watch. A call to the firehouse to review drawings before closing the second valve could have identified the piping connection that supplied water to the other building.

At Pantex, Fire Department personnel had isolated a fire suppression deluge system in a building to allow the startup of an air handler. They were concerned that the air handler could cause a blast of hot air sufficient to activate the deluge system. While they were isolating the deluge system, a leaking valve caused a flow alarm on the fire alarm panel. Personnel silenced the local fire alarm bells by placing a switch on the panel in the "silence" position but failed to inform the fire chief of this action. Fire Department personnel eventually had to shut down a jockey pump to complete the isolation. They installed impairment tags on the valve and pump but failed to tag the fire alarm panel. The next day they removed the impairment tags but the fire alarm panel remained in its impaired state for the next week. After discovery of the fire alarm panel impairment, the assistant fire chief immediately reviewed the Fire Department impairment status board and discovered that there was no record of impairment of panel. Fire Department personnel immediately conducted a comprehensive review of all facility fire system impairments and fire alarm signals annunciated on the fire alarm computer system. They learned that personnel had also failed to identify the alarm impairment during routine reviews of computer system printouts. Although the fire suppression system would have functioned during a fire, the flow alarm would not have been able to notify the Fire Department of the actuation.

In Weekly Summary 98-41, NFS reported on a recent event at the Idaho Nuclear Engineering and Technology Center, where electronics technicians discovered a mispositioned "trouble/silence" switch in a fire supervisory panel. The switch was found in the "silence" position after an expected trouble alarm

did not annunciate. The switch position suppressed local alarms and the transmission of trouble alarms to the main fire alarm control room. Investigators believe that someone operated the switch to silence a local alarm caused by an electrical outage but failed to reposition it after power was restored. (ORPS Reports ID--LITC-WASTEMNGT-1998-0019)

Some fire protection system impairments may not be as obvious as those that directly affect alarm and monitoring systems or fire protection system alignments. The ability of a fire protection system to perform its intended function can also be impaired by unknowingly increasing the fire loading in the area serviced, or by construction activities associated with building structures, as seen in the following two examples.

- On November 10, 1998, a facility manager at the Savannah River Tritium Facilities reported that missing ceilings in areas of a building had impaired the fire protection system since May 1998. The missing ceilings would allow heat to rise and collect in higher overhead areas, precluding early activation of sprinklers. A construction project that required removal of the ceilings lacked sufficient funds to complete the work and resolve the fire protection system impairments. (ORPS Report SR--WSRC-TRIT-1998-0016)

- Weekly Summary 98-04 reported that a shift technical advisor at the Rocky Flats Plutonium Processing and Handling Facility discovered that a construction subcontractor had removed ceiling tiles from around sprinkler heads without implementing compensatory measures, resulting in an operational safety requirement violation. Removing the ceiling tiles could affect fire suppression system operation because the sprinkler heads are suspended below the ceiling and the tiles act as a heat reflector to ensure that the sprinkler heads activate in the event of a fire. (ORPS Report RFO--KHLL-371OPS-1998-0005)

These events underscore the importance of ensuring that fire protection systems are maintained in operational readiness. Work activities that render portions of these systems inoperable need to be controlled and documented. Compensatory measures, such as establishing fire watches, need to be implemented, and facility management must be informed of any change in fire protection system status. Facility managers should ensure that work controls are rigorous enough to prevent unplanned system impairments and are adequate to maintain facility and personnel safety during planned impairments. These events also underscore the need for attention to detail by personnel who operate and maintain fire protection systems.

DOE O 420.1, *Facility Safety*, requires fire protection systems for DOE facilities to include means for notifying and evacuating building occupants and means for summoning a fire department. Fire protection supervisory systems detect conditions indicative of fire, actuate local warnings, transmit notifications to a continuously attended location, and in some cases, actuate systems to extinguish or limit the spread of fire and smoke. The Order also states that fire protection systems shall be designed such that their inadvertent operation, inactivation, or failure of structural stability will not result in the loss of vital safety functions or inoperability of safety class systems as determined by the safety analysis report.

DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter VIII, "Control of Equipment and System Status," states that DOE facilities are required to establish administrative control programs to handle configuration changes resulting from maintenance, modifications, and testing activities. DOE O 4330.4B, *Maintenance Management Program,* chapter 15, "Management Involvement," identifies the degree of management involvement in oversight and approval of maintenance activities. Chapter II, section 8.3.1, "Work Control Procedure," states that work control procedures help personnel understand

the necessary requirements and controls. DOE-STD-1050-93, *Guideline to Good Practices for Planning, Scheduling and Coordination of Maintenance at DOE Nuclear Facilities*, section 3.1.1.3, provides the key elements of an effective planning program. The standard also discusses the need for thorough reviews of work packages by experienced individuals to eliminate errors.

KEYWORDS: alarm, fire protection, fire suppression, switch, work control

FUNCTIONAL AREAS: Fire Protection, Work Control

4. OCCUPATIONAL RADIATION EXPOSURE TO URANIUM

On November 2, 1998, at the Oak Ridge East Tennessee Technology Park, an operations manager learned that bioassay samples taken from a laborer indicated an occupational exposure to uranium. The laborer was involved in removal of equipment and cleanup in a contaminated area of a building where enriched uranium processing was performed. An initial sample result of 50 µg/l, submitted by the laborer on July 25, 1998, exceeded the project's Derived Investigation Level for a uranium urinalysis. An isotopic analysis of this sample was consistent with an exposure to natural uranium. On October 2, the laborer submitted a follow-up sample that indicated 11,700 µg/l. An isotopic analysis of this sample indicated an exposure to enriched uranium. Investigators concluded that the bioassay results were indicative of two separate exposures and that the laborer ingested 420 mg of material within 6 hours of the October 2 bioassay. This would correspond to a CEDE of 180 mrem and a Committed Dose Equivalent to the bone surfaces of 2.6 rem. (ORPS Report ORO--BNFL-K33-1998-0012)

On October 27, an occupational physician examined the laborer to assess the possibility of uranium exposure health effects such as renal damage. The physician detected no adverse health effects. The laborer received an in vivo (lung count) measurement at the Oak Ridge National Laboratory. The lung count detected no uranium in his body. The laborer was administered a chelating agent and has been restricted from entering the radiological control area. Investigators suspect that the first uptake may have occurred on July 18, 1998, when the laborer participated in the removal of compressor bolts with an air impact wrench, in violation of the radiological work permit requirement prohibiting the use of air-powered tools in the area. Facility managers continue to investigate the causes of the uptakes. OEAF engineers will follow the investigation and provide information as it becomes available.

NFS reported another internal exposure event in Weekly Summary 97-33, where a Type B Accident Investigation was undertaken to determine how the individual received the uptake. On February 10, 1997, an F-Canyon crane operator's routine, semiannual bioassay sample was positive for plutonium. Follow-up bioassay samples indicated he may have received an estimated occupational exposure of 17 rem, 50-year CEDE. The 17-rem CEDE results in an actual first-year dose of approximately 750 mrem. Inhalation was the mechanism for the uptake, based on the rate and pathways of elimination from the body. The Type B Accident Investigation Board determined the direct cause of the uptake was the operator's failure to wear respiratory protection in an airborne radioactivity area. The root cause was a lack of discipline in fully implementing radiological controls and requirements for peripheral work in radiological areas. The contributing causes were (1) lack of operations supervision and management oversight for peripheral work, (2) lack of radiological controls supervision and management oversight for peripheral work, and (3) inadequate management analysis of operational and radiological conditions associated with peripheral work. (ORPS Report SR--WSRC-FCAN-1997-0009 and Type B Accident Investigation Board Report of the Plutonium Intake by a Crane Operator at the Savannah River Site F-Canyon)

These events illustrate the importance of fully evaluating all potential hazards that could result in inhalation or ingestion of radioactive material. DOE/EH-0256T, *Radiological Control Manual*, section 136, states that control and prevention of internal exposure to long-lived radionuclides in the workplace

presents special challenges that warrant particular attention. Because of the difficulty of measuring transuranic uptakes that result in low doses, specific actions are required minimize the risks of internal exposure. In order to minimize internal exposures, managers should take deliberate actions to control contamination at the source and reduce areas of airborne radioactivity, contamination, and high contamination. Managers should also anticipate radioactive hazards associated with past facility operations and include them as part of the work planning process.

KEYWORDS: internal exposure, intake/uptake, uranium

FUNCTIONAL AREAS: Radiation Protection

FINAL REPORTS

This section of the OEWS discusses events filed as final reports in the ORPS. These events contain new or additional lessons learned that may be of interest to personnel within the DOE complex.

1. ANALYST RECEIVES INTERNAL RADIATION EXPOSURE

On September 1, 1998, at the Idaho National Environmental and Engineering Laboratory, the radiation control supervisor at the Idaho Nuclear Technology and Engineering Center (INTEC) received routine annual fecal bioassay results indicating that a laboratory analyst had received an uptake of plutonium-239. The analyst submitted additional fecal samples on September 3, 8, 15, and 22. These follow-up samples showed no radioactivity, indicating that the initial bioassay result had been due to ingestion, not inhalation. The committed effective dose equivalent associated with the ingestion is less than 0.1 mrem. Investigators determined that the analyst worked on samples of plutonium-contaminated graphite molds, and that the requirement to work on the samples inside a glovebox was not adequately communicated to him. Failure to adequately communicate radiological hazards resulted in the analyst receiving an internal radiation exposure. (ORPS Report ID--LITC-LANDLORD-1998-0027)

Investigators determined that the analyst worked on samples of graphite molds contaminated with weapons-grade plutonium. The samples came from Rocky Flats. They were received by the INTEC sample custodian, who generated a request for analysis using the laboratory computer system. The custodian entered the information that the samples were “high alpha.” The analyst who worked on the samples was not required to review this information. The alpha activity was not indicated on the sample label, and oral instructions to handle the samples in a hot cell or glovebox were not effectively communicated to the analyst. Because the analyst was unaware of the alpha hazard, he worked on the samples in accordance with the radiation work permit guidance for samples with beta/gamma activity.

The facility manager determined that the direct cause of the intake was that the analyst had not worked on the sample in a glovebox. He also determined that the root cause was a work control process that failed to adequately communicate hazards to the analyst and ensure that the proper mitigative measures were used. The facility manager determined that contributing causes were inadequate supervision, inadequate labels, and an inadequate radiological work permit.

NFS reported in Weekly Summary 98-11 that the DOE Office of Enforcement and Investigation issued a Preliminary Notice of Violation under the Price-Anderson Amendments Act to Lawrence Livermore National Laboratory for multiple failures to implement radiological protection requirements and provide the quality controls necessary to protect workers involved in High Efficiency Particulate Air (HEPA) filter

shredding operations. On July 2, 1997, five workers received curium intakes and spread contamination in a laboratory room when they shredded a HEPA filter. Investigators determined that waste characterization data was available for the shredded HEPA filter, but the data was incorrectly identified on the HEPA-filter waste storage box label and on the radioactive waste disposal requisition form. (NTS Report NTS-SAN--LLNL-LLNL-1997-0001; ORPS Report SAN--LLNL-LLNL-1997-0038; DOE/OAK-540, Rev. 0, "Type B Accident Investigation Board Report of the July 2, 1997, Curium Intake by Shredder Operator at Building 513 Lawrence Livermore National Laboratory, Livermore, California," August 1997; Letter, DOE (P. Brush) to Lawrence Livermore National Laboratory (R. Kuckuck), 03/09/98; Lawrence Livermore National Laboratory Nuclear Facility Safety Appraisal, "Status of FSP and OSP Implementation," 11/96)

These events illustrate the need for good hazard communication in the laboratory environment. Good hazard communication includes proper labeling of all hazardous and radioactive material containers. Labels should be understandable to laboratory workers, emergency response teams, and others. The following references contain guidance for good radiation control and hazard communications practices.

- DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*, describes the required elements of a worker protection program at DOE facilities. Section 14.a(2) of attachment 2, "Contractor Requirements Document," states that workers shall be informed of foreseeable hazards and required protective measures before starting work on the affected operation.

- DOE/EH-0256T, *Radiological Control Manual*, Chapter 1, "Excellence in Radiological Control," describes key principles common to successful, well-managed radiological control programs.

- National Research Council Publication ISBN 0-309-05229-7, *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals,* 1995, provides recommendations for reducing the risk of exposure to radioactive materials. The recommendations include the following.

    1. Know the characteristics of the radioisotopes.

    2. Protect against exposure to airborne and ingestible radioactive materials.

    3. Never eat, drink, smoke, handle contact lenses, apply cosmetics, or take or apply medicine in the laboratory.

    4. Do not pipet by mouth.

    5. Provide for safe disposal of waste radionuclides.

    6. Use equipment that can be manipulated remotely, as well as shielding, gloveboxes, and personal protective equipment, including gloves, clothing, and respirators, as appropriate.

    7. Plan procedures so as to minimize exposure.

Information on how to order this book can be obtained from the National Academy Press, 2101 Constitution Avenue, N.W., Washington, D.C. 20418. This book can also be ordered from most large book stores.

- DOE-STD-1031-92, *Guide to Good Practices for Communications*, discusses the need for clear, formal, and disciplined communications and provides guides to improve communications.

KEYWORDS: alpha, communication, glovebox, hood, intake, labeling, plutonium

FUNCTIONAL AREAS: Industrial Safety, Materials Handling and Storage, Radiation Protection, Work Planning

2. SLUDGE SPRAYS WORKERS WHEN PUMP DISCHARGE HOSE IS DISCONNECTED

On October 2, 1998, at the Savannah River Effluent Treatment Facility, three subcontracted workers were sprayed with sediment while disconnecting a clogged pump discharge hose. The incident occurred inside a contamination area and the individuals were wearing the appropriate protective clothing. A radiological controls technician monitored them and detected low-level contamination on their faces and protective clothing. The technician wiped mud and sediment from the workers' faces and the workers removed their protective clothing, after which two surveys showed no skin contamination. The subcontractor supervisor stopped work and initiated a safety stand-down until causes could be determined and corrected. Although this occurrence did not result in injury or extensive contamination, opening pressurized systems can have serious consequences. (ORPS Report SR--WSRC--ETF-1998-0005)

Investigators determined that the workers were using a positive displacement diaphragm pump to transfer sludge from a retention basin to waste boxes when a blockage occurred in the discharge line. While preparing to remove the discharge line at a quick disconnect coupling, a worker released one side of the coupling and rocked it in an attempt to relieve any pressure in the line. However, pressure trapped between the blockage and the pump propelled contaminated sludge from the line when he released the other side of the coupling.

Investigators cited inadequate or defective design as both the direct and root causes of this occurrence, because no means had been provided to manually vent pressure from the discharge side of the pump. Corrective action consisted of installing a spool piece with a vent and relief valve as the first in-line component on the pump discharge. They cited personnel error as a contributing cause because workers did not recognize that more than one person is directly involved in disconnecting the discharge line. The work clearance permit required personnel disconnecting the line to wear face protection. Workers interpreted this to mean that a face shield was required for the person actually disconnecting the line, but not for the two persons needed to hold a drip bag under the connection. Corrective actions consisted of requiring face shields for all workers and securing the drip bag at the joint mechanically instead of by hand.

NFS reported a similar event in Weekly Summary 96-45. Potentially contaminated sludge sprayed five workers at the Savannah River L-Reactor Facility when a mechanic disconnected a pressurized discharge hose from a positive displacement pump. The sludge sprayed 10 feet, hitting three people working inside a contamination area and two others outside the area. The mechanic, dressed in a plastic suit, was troubleshooting the pump to determine why it was not operating. When he opened a quick-disconnect coupling, the hose blew 3 inches into the air and sprayed the surrounding area. Personnel surveys and samples of the sludge indicated no contamination. Investigators attributed the occurrence to an error in material or equipment selection because no means had been provided to relieve pressure buildup in the pump discharge line. (OPRS Report SR--WSRC-REACL-1996-0005)

Each of these events resulted in a reduced safety margin for nearby workers. They illustrate the need for caution when opening systems that contain potentially hazardous materials with unknown or suspect pressure. Contamination or injury can result even if protective equipment is worn. A contributing factor to the event at L-Reactor was failure to recognize that pressure can become trapped in the discharge lines of positive displacement pumps. The method used at the Effluent Treatment Facility was not effective in relieving residual pressure. Workers should be trained to recognize conditions where residual pressure may exist. Recommended precautions when opening systems under such conditions include using additional shielding between personnel and the break point and keeping personnel out of the path of potential discharges.

KEYWORDS: contamination, pump, spray, pressurized

FUNCTIONAL AREAS: operations, radiation protection